

WHAT IS CLAIMED IS:

1. A device for conducting processing steps on a substrate comprising an array of chemical compounds on a surface thereof, said device comprising:

- 5 (a) a housing comprising a housing chamber,
- (b) an opening in said housing adapted for insertion of a substrate having a surface comprising an array of chemical compounds into said housing chamber,
- (c) a fluid separation mechanism for separating fluid from contact with said substrate in a controlled manner so that the integrity of the fluid meniscus at the atmosphere-fluid interface is preserved,
- 10 (d) at least one inlet in fluid communication with said housing chamber and
- (e) at least one outlet in fluid communication with said housing chamber.

2. A device according to Claim 1 further comprising a tilt mechanism for

15 controlling the orientation of said device.

3. A device according to Claim 1 wherein said fluid separation mechanism is a lifting mechanism for lifting said substrate out of contact with said fluid in a controlled manner.

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4. A device according to Claim 3 wherein said lifting mechanism lifts said substrate out of said housing chamber in a controlled manner at a rate that substantially eliminates droplet formation of said fluid on said substrate.

25 5. A device according to Claim 1 wherein said fluid separation mechanism is a fluid removal mechanism for removing fluid from said housing chamber in a controlled manner.

6. A device according to Claim 5 wherein said fluid removal mechanism

30 removes fluid from said housing chamber in a controlled manner at a rate that substantially eliminates droplet formation of said fluid on said substrate.

7. A device according to Claim 5 wherein said fluid removal mechanism lifts said substrate out of said housing chamber in a controlled manner at a rate that substantially eliminates droplet formation of said fluid on said substrate.

5 8. A device according to Claim 5 wherein said fluid removal mechanism comprises a valve or a pump.

9. A device according to Claim 8 wherein said fluid removal mechanism comprises a valve having a varying cross-section relative to height of fluid in said  
10 housing chamber.

10. A device according to Claim 8 wherein said fluid removal mechanism comprises a pump having a constant displacement.

15 11. A device according to Claim 1 further comprising a temperature controller.

12. A device according to Claim 1 further comprising a separator mechanism for separating a sandwich of a substrate and a cover slide inserted into said housing  
20 chamber.

13. A device according to Claim 12 wherein said separator mechanism comprises a pair of flexible members having a wedge member therebetween.

25 14. A device according to Claim 1 further comprising a means for cooling a fluid.

15. A device according to Claim 1 further comprising a heat exchanger for heating and/or cooling a fluid.

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16. A device according to Claim 1 further comprising a solvent vapor generator.

17. A device according to Claim 1 wherein said housing chamber comprises a substrate comprising a chemical array on the surface thereof.

18. A device according to Claim 17 wherein said chemical array is a  
5 biopolymer array.

19. A method for conducting a processing step on a substrate comprising a surface having an array of chemical compounds thereon, said method comprising:

- (a) bringing said surface into contact with a processing fluid, and
- 10 (b) removing said surface from contact with said fluid in a controlled manner at a rate that substantially eliminates droplet formation of said fluid on said surface of said substrate.

20. A method according to Claim 19 wherein said removing is accomplished  
15 by lifting said substrate from contact with said fluid in a substantially vertical manner.

21. A method according to Claim 19 wherein said removing is accomplished by draining said fluid away from said substrate.

22. A method according to Claim 19 wherein said draining is accomplished  
20 by employing a valve that comprises a varying cross-section relative to height of fluid in contact with said substrate or by employing a pump having a constant displacement.

23. A method according to Claim 19 further comprising providing a fluid  
25 vapor at a fluid/air interface during said removing.

24. A method according to Claim 19 wherein said chemical compounds are biopolymers and said processing step is a step in the hybridization of an array of biopolymers on said surface.

30 25. A method according to Claim 24 wherein said biopolymers are polynucleotides or polypeptides.

26. A method according to Claim 21 wherein said draining is assisted by tilting said substrate.

27. A method according to Claim 19 wherein said surface is maintained free  
5 of exposure to ambient atmosphere when in contact with said fluid.

28. A method according to Claim 19 wherein said processing fluid is a buffer solution for removing unbound target molecules and said surface is maintained wet at least until a subsequent processing step.

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29. A method for performing a step of a hybridization reaction on the surface of a substrate, said method comprising:

(a) inserting a substrate comprising an array of chemical compounds on a surface thereof into a housing chamber of a device according to Claim 1,

15 (b) introducing a fluid reagent for performing said step into said housing chamber, and

(c) removing said fluid reagent from contact with said substrate in a controlled manner at a rate that substantially eliminates droplet formation of said fluid on said surface of said substrate.

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30. A method according to Claim 29 wherein said step is washing said surface and/or drying said surface.

31. A method according to Claim 29 wherein said removing is carried out by  
25 lifting said substrate from said housing in a controlled manner.

32. A method according to Claim 29 wherein said removing is carried out by a removal mechanism selected from the group consisting of (i) a valve having a varying cross-section relative to height of fluid in said housing chamber and (ii) a pump having a  
30 constant displacement.

33. A method according to Claim 29 further comprising introducing a fluid vapor into said housing chamber during said removing to assist in drying said substrate surface.

5 34. A method according to Claim 33 wherein said fluid vapor is a vapor of an organic solvent.

35. A method according to Claim 29 further comprising tilting said device during said removing.

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36. A method according to Claim 29 wherein said substrate is part of sealed hybridization chamber and said method comprises disassembly of said hybridization chamber in the presence of disassembly buffer.

15 37. An apparatus for conducting a processing step of a hybridization reaction involving an array of biopolymers on the surface of a substrate, said apparatus comprising:

- (a) one or more devices according to Claim 1,
- (b) one or more fluid reagent reservoirs in fluid communication with one or  
20 more of said devices,
- (c) a tilt mechanism for controlling the orientation of each of said devices,
- (d) one or more pumps for controlling the flow of fluid reagents into each of said devices,
- (e) at least one heat exchanger for controlling the temperature of said fluid  
25 reagents, and
- (f) a portion of a lifting mechanism external to said devices wherein said lifting mechanism lifts said substrate out of contact with a fluid reagent in a controlled manner.

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38. An apparatus according to Claim 37 further comprising a transfer mechanism for moving a substrate to and from said devices.

39. An apparatus according to Claim 37 further comprising a thermally  
5 insulating member around at least a portion of each of said devices.

40. A method for analyzing a liquid sample, said method comprising  
contacting said liquid sample with a surface of a substrate comprising a plurality of  
chemical compounds and processing said surface in an apparatus according to Claim 37.  
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41. A method according to claim 40 further comprising exposing the array to  
a sample and reading the array.

42. A method comprising forwarding data representing a result obtained  
15 from a reading of an array exposed according to the method of Claim 41.

43. A method according to claim 42 wherein the data is transmitted to a  
remote location.

20 44. A method comprising receiving data representing a result of an  
interrogation obtained by reading of an array exposed according to the method of Claim  
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45. A flow device comprising:  
25 (a) a reaction chamber having an opening for insertion of a substrate into  
said reaction chamber, said substrate having a cover slide over a surface thereof wherein  
said surface comprises a plurality of biopolymers and  
(b) a separator mechanism for separating said substrate surface and said  
cover slide while in said reaction chamber without damage to said biopolymers on said  
30 surface.

46. A flow device according to Claim 45 wherein said separator mechanism comprises a pair of flexible members having a wedge member therebetween and disposed to insert between and separate said substrate surface and said cover slide.